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EXAMINER
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DALEY, CLIFTON G

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2624

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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

## Office Action Summary

Application No.

10/687,179

Applicant(s)

SMITH, DAVID R.

Examiner

Clifton G. Daley

Art Unit

2624

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 13 November 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-44 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-44 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
- Paper No(s)/Mail Date \_\_\_\_\_

- 4) ☐ Interview Summary (PTO-413)
- Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Response to Amendment***

This action is Non-Final. Claims 1-44 are currently pending. Applicant's response received on 11/13/2007 is fully considered herein. Original 102(b) rejections have been withdrawn and new 103(b) rejections have been provided.

### ***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. **(New grounds)** Claims 1-5 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii et al. (Hereinafter "Fujii"; US 5594768) in view of Lee et al. (Hereinafter "Lee"; "DULLRAZOR®: A Software Approach to Hair Removal from Images", 1997, Elsevier Science Ltd., Computers in Biology and Medicine, Vol. 27, No. 6, pp. 533-543).

**(New 103(a) rejection)** Regarding **claim 1**, Fujii teaches a method for deshadowing a laminographic image comprising: constructing one or more

morphological filters (**column 21, lines 22-27, i.e. morphological processing**);  
and

applying said filters to a laminographic image including images of said objects  
(**column 20, lines 57-66**).

Fujii does not explicitly disclose using expected sizes of the objects to be imaged  
in the construction of the one or more morphological filters.

However, Lee discloses constructing one or more morphological filters using  
expected sizes of the objects to be imaged (**page 536, lines 6-8, i.e. three filter  
structures based on object thickness and orientation**).

It would have been obvious to one of ordinary skill in the art at the time the  
invention was made to have used Lee's morphological filtering method to process Fujii's  
laminographic image, the motivation to combine being to minimize or remove linear  
patterns in the image (**Fujii: column 22, lines 62 to column 23 line 4**).

**(New 103(a) rejection)** Regarding **claim 2**, Fujii in combination with Lee  
teaches the method of claim 1, further comprising: differentiating, after said applying, a  
background of said image from said images of said objects to remove said background  
(**Lee: page 536, lines 13-17**).

**(New 103(a) rejection)** Regarding **claim 3**, Fujii in combination with Lee  
teaches the method of claim 2 further comprising: thresholding an image resulting from  
said differentiating to provide a binary image of said objects (**Lee: page 536, lines  
17-21**).

**(New 103(a) rejection)** Regarding **claim 4**, Fujii in combination with Lee teaches the method of claim 3 further comprising extracting said image resulting from said thresholding to disclose pixels representing said objects **(Lee: page 536, lines 10-12, i.e. hair mask)**.

**(New 103(a) rejection)** Regarding **claim 5**, Fujii in combination with Lee teaches the method of claim 1 wherein said morphological filter employs a dilation **(Lee: page 536, line 13, i.e., a morphological closing, which is by definition a dilation followed by an erosion)**.

**(New 103(a) rejection)** Regarding **claim 12**, Fujii in combination with Lee teaches the method of claim 1 wherein said morphological filter employs a closing **(Lee: page 536, line 13)**.

**Summary of applicant's remarks:** Regarding claims 1-5 and 12, Lee does not disclose the construction of one or more morphological filters "using expected sizes of the objects to be imaged".

Lee does not teach application of morphological filters to a "laminographic image" and "deshadowing" of a laminographic image.

**Examiner's response:** Lee discloses the construction of or more morphological filters for the purpose of removing thick and dark hairs from an image (page 534, line 15). Lee discloses structuring elements of sizes suitable for the purpose (page 536, lines 6-8). It is inherent in the mathematics of Lee's disclosure (i.e. morphological closing (page 536, lines 3-4)) that the disclosed sizes of the structuring elements are

based on the expected size (i.e. thickness and orientation as imaged by the disclosed system (page 534, section 2)) of the objects imaged. The inherency is supported by evidentiary reference Parker (J.R. Parker, "Algorithms for Image Processing and Computer Vision", 1997, Wiley Computer Publishing, Chapter 2.3, pp. 103-113) i.e. size of structuring element larger than object in order to remove it, page 112, line 15 to page 114, line 4, in view of evidentiary reference Loce et al. (Hereinafter "Loce"; US 6297889), column 6, lines 49-52) i.e. relationship between "closing" and "opening".

The lack of limitation with respect to the application of morphological filters to a "laminographic image" and "deshadowing" of a laminographic image is resolved in the combination of Lee with Fujii.

The original 102(b) rejections are withdrawn and a alternate 103(a) rejections are provided above.

3. **(New grounds)** Claims 21, 23 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii in view of Loce.

**(New 103(a) rejection)** Regarding **claim 21**, Fujii teaches a method for deshadowing a laminographic image comprising:

performing a mathematical morphological operation on said image **(column 21, lines 22-27, i.e. morphological processing)**.

Fujii does not disclose

selecting a mathematical morphology structuring element larger than examination elements of a laminographic image to be inspected; and

differentiating, after performance of said mathematical morphological operation, a background of said image from said examination elements to remove said background.

Loce, working in the same field of endeavor of image processing, teaches an image processing method comprising: selecting a mathematical morphology structuring element larger than examination elements of an image to be inspected (**Column 8, lines 62-63, i.e. structuring element  $K_1$  (Fig. 7) larger than examination element (i.e. hole, column 7, lines 57-58)**);

performing a mathematical morphological operation on said image (**column 8, lines 63-64**); and

differentiating, after performance of said mathematical morphological operation, a background of said image from said examination elements to remove said background and deshadow the image (**column 8, lines 63-64**).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have applied Loce's image processing method to Fujii's laminographic image, the motivation to combine being to minimize or remove size dependant artifacts from the image (**Loce: column 3, lines 40-47**).

**(New 103(a) rejection)** Regarding **claim 23**, Fujii in combination with Loce teaches the method of claim 21 wherein said mathematical morphological operation is a closing (**Loce: column 8, line 64**).

**(New 103(a) rejection)** Regarding **claim 25**, Fujii in combination with Loce teaches the method of claim 21 wherein said image is a negative and said mathematical morphological operation is an opening (**Loce: column 6, lines 50-53, i.e. an opening performed on a negative (background) is disclosed to be equivalent to a closing performed on the original**).

**Summary of applicant's remarks:** Regarding claims 21, 23 and 25, Loce does not teach deshadowing a laminographic image.

The primary goal of Loce's methods is to preserve shadow detail, rather than to "deshadow" an image.

Loce's structural element  $K_1$  is not used to isolate single-pixel holes.

Loce's "comparable size" in column 10, line 3 does not read on "larger".

**Examiner's Response:** The lack of limitation in Loce's method is resolved in the combination with Fujii. The image processing method disclosed by Loce is not dependent on a primary goal, but can be applied to any image. In particular, it can be applied to Fujii's laminographic image to achieve the goal of "deshadowing a laminographic image".

Loce's structural element  $K_1$  is disclosed as an example element to isolate single pixel holes (Loce, column 7, lines 57-58 and column 8, lines 49-54). Loce discloses  $K_1$  as the structure used to isolate holes using a morphological closing followed by a difference (Fig.6, 60B). Loce further discloses a "closing" as a "dilation" followed by an "erosion" (column 6, lines 35-54). It is inherent in Loce's disclosure that in order to



isolate holes as described, the structuring element used must be at least as large as the hole to be isolated. Loce therefore discloses using a structuring element larger than the examination elements to be inspected as recited in claim 21. While Loce goes on to describe a hole in a binary image as "a small region of zero-valued pixels" (column 9, lines 63-64), Loce's example of a single-pixel hole fits the description of a "small region".

Based on the above analysis of Loce's structuring element, it is likewise inherent in Loce's disclosure that "comparable size" reads on "larger".

The original 102(b) rejections are withdrawn and alternate 103(a) rejections are provided above.

4. **(New grounds)** Claims 41-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii in view of Shih.

**(New 103(a) rejection)** Regarding **claim 41**, Fujii teaches a method for deshadowing a laminographic image comprising: selecting a mathematical morphology structuring element **(column 21, lines 22-27, i.e. morphological processing)**.

Fujii does not disclose an ultimate mathematical morphology structuring element radius larger than examination elements of a laminographic image to be inspected.

However, Shih discloses a morphological process comprising:

selecting an ultimate mathematical morphology structuring element radius larger than examination elements of an image to be inspected **(page 1, right column, lines 3-6 and page 357, equation 5, i.e. radius  $i = n$ ,  $n$  larger than image details**

**(examination elements) to be eliminated**); setting an initial slope for said structuring element **(page 363, Fig. 3, i.e.  $m_1$ )**; setting an initial radius of said structuring element to one **(page 357, equation 5, i.e. radius  $i=1$ )**; performing a mathematical morphological operation on said image by said set slope to said set radius to achieve a resulting image **(page 357, equation 12, i.e. first dilation in the sequence)**; setting a new slope for said structuring element **(page 363, Fig. 3, i.e.  $m_2$ )**; increasing the radius of said structuring element **(page 363, Fig. 3, i.e. size  $s_2 > s_1$ )**; performing a mathematical morphological operation on said resulting image by the new slope to the increased radius to achieve a new resulting image **(page 357, equation 12, i.e. second dilation in the sequence)**; and repeating said setting a new slope, increasing radius, and performing a mathematical morphological operation, on said new resulting image, if the increased radius does not equal said ultimate mathematical morphology structuring element radius **(page 357, equation 12, i.e. last dilation is at radius  $i = n$ )**.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have applied Shih's structuring element sequence in Fujii's morphological processing, the motivation to combine being to minimize or remove size dependant artifacts from Fujii's laminographic image **(Fuji: column 22, line 63 to column 23, line 4)**.

Regarding **claim 42**, Shih teaches the method of claim 41 wherein said mathematical morphological operation is a dilation **(page 357, equation 12)**.

Regarding **claim 43**, Shih teaches the method of claim 41 wherein said mathematical morphological operation is an erosion (**page 357, equation 12**).

**Summary of applicant's remarks:** Regarding claims 41-43, Shih teaches a method for performing mathematical morphology by varying the radii and slope of successively applied structuring elements. However shih does not teach that the "ultimate" element radius "n" is larger than examination elements of a laminographic image to be inspected.

**Examiner's Response:** The lack of limitation in Shih's method with regards to the laminographic image is resolved in the combination with Fujii. The combined teaching of Fujii and Shih discloses the "ultimate" element radius "n" as being larger than examination elements of a laminographic image to be inspected.

The original 102(b) rejections are withdrawn and alternate 103(a) rejections are provided above.

5. **(New grounds)** Claims 6-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii combined with Lee as applied to claim 5 above, and further in view of Segall et al. (Hereinafter "Segall"; "Video tracking using morphological pyramids", 1999, SPIE and IS&T, Journal of Electronic Imaging, April 1999, Vol. 8(2))

**(New 103(a) rejection)** Regarding **claim 6**, Fujii combined with Lee teaches the method of claim 5. Fujii combined with Lee does not teach the method wherein said dilation uses a power of two structuring element.

However, Segall discloses a method wherein dilation uses a power of two structuring element (**page 177, right column, lines 28-36, i.e. reducing image resolution by a factor of 2 increases the relative size of the structuring element by a factor of 2**).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Lee with Segall's method. The motivation to combine being to improve computational efficiency and system robustness (**Segall: page 182, right column, lines 3-4**).

**(New 103(a) rejection)** Regarding **claim 7**, Fujii combined with Lee teaches the method of claim 5. Fujii combined with Lee does not teach the method wherein said dilation uses a bi-directional power-of-two structuring element.

However, Segall discloses a method wherein dilation uses a bi-directional (**i.e. rows and columns, page 177, right column, lines 34-36**) power of two structuring element (**page 177, right column, lines 28-36, i.e. reducing image resolution by a factor of 2 increases the relative size of the structuring element by a factor of 2**).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Lee with Segall's method. The motivation to combine being to improve computational efficiency and system robustness (**page 182, right column, lines 3-4**).

**(New 103(a) rejection)** Regarding **claim 8**, Fujii combined with Lee teaches the method of claim 5. Fujii combined with Lee does not teach the method wherein said morphological filter computes morphological operators such that the area of influence of the structuring element expands in a plurality of directions by up to a power of two during said computation.

However, Segall discloses a method wherein a morphological filter computes morphological operators **(page 177, left column, equation 1, i.e. using structuring element K as in page 177, right column, lines 16-22)** such that the area of influence of the structuring element expands in a plurality of directions **(i.e. rows and columns, page 177, right column, lines 34-36)** by up to a power of two during said computation **(page 177, right column, lines 28-36, i.e. reducing image resolution by a factor of 2 increases the area of influence of the structuring element by a factor of 2)**.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Lee with Segall's method. The motivation to combine being to improve computational efficiency and system robustness **(page 182, right column, lines 3-4)**.

**Summary of applicant's remarks:** Claims 6-8 depend from claim 1, and Segall does not teach that which is missing from Lee.

**Examiner's Response:** Regarding claims 6-8, the lack of limitation in Lee is resolved in the combination of Fujii with Lee. That which is missing from the combined teaching of Fujii and Lee is taught by Segall.

The original 103(a) rejections are withdrawn and alternate 103(a) rejections are provided above.

6. **(New grounds)** Claims 9-11 and 15-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii combined with Lee as applied to claim 5 above, and further in view of Shih.

**(New 103(a) rejection)** Regarding **claim 9**, Fujii combined with Lee teaches the method of claim 5. Fujii combined with Lee does not teach the method wherein said dilation uses a terraced structuring element.

However, Shih discloses the use of a terraced structuring element (**page 363, Fig. 3., i.e. a convex element with  $s_1$  smaller than  $s_2$  smaller than  $s_3$** ).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Lee with Shih's method. The motivation to combine being to improve performance.

**(New 103(a) rejection)** Regarding **claim 10**, Fujii combined with Lee teaches the method of claim 5. Fujii combined with Lee does not teach the method wherein said dilation uses a sloped structuring element.

However, Shih discloses the use of a sloped structuring element (**page 362, Fig. 1.**).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Lee with Shih's method. The motivation to combine being to improve performance.

**(New 103(a) rejection)** Regarding **claim 11**, Fujii combined with Lee and Shih, teaches the method of claim 10 above, wherein said dilation uses a smoothly sloped structuring element **(Shih: page 362, Fig. 1)**.

**(New 103(a) rejection)** Regarding **claim 15**, Fujii combined with Lee teaches the method of claim 1. Fujii combined with Lee does not teach the method wherein said morphological filter employs an operation comprising decomposing a structuring element.

However, Shih discloses a method of decomposing a structuring element **(page 356, right column, lines 42-45)**.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Lee with Shih's method. The motivation to combine being to reduce calculations **(Shih: page 356, right column, lines 23-24)**.

**(New 103(a) rejection)** Regarding **claim 16**, Fujii combined with Lee and Shih teaches the method of claim 15 above wherein said morphological filter employs an operation comprising at least one piecewise linear dilation by a structuring element of limited support **(Shih: page 356, equation 1, with structuring element k as in page 363, Fig. 3)**.

**(New 103(a) rejection)** Regarding **claim 17**, Fujii combined with Lee and Shih teaches the method of claim 15 above wherein said morphological filter employs an operation comprising at least one piecewise linear erosion by a structuring element of limited support **(Shih: page 356, equation 2, with structuring element k as in page 363, Fig. 3).**

**Summary of applicant's remarks:** Claims 9-11 and 15-17 depend from claim 1, and Shih does not teach that which is missing from Lee.

**Examiner's Response:** Regarding claims 9-11 and 15-17, the lack of limitation in Lee is resolved in the combination of Fujii with Lee. That which is missing from the combined teaching of Fujii and Lee is taught by Shih.

The original 103(a) rejections are withdrawn and alternate 103(a) rejections are provided above.

7. **(Original grounds)** Claims 18-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii in view of Lee.

**(Original 103(a) rejection)** Regarding **claim 18**, Fujii in combination with Lee teaches the method of claim 1 wherein the objects are solder joints **(Fujii: Fig. 5, solder joints 25).**

**(Original 103(a) rejection)** Regarding **claim 19**, Fujii in combination with Lee teaches the method of claim 18 above wherein said objects are solder joints on a circuit board **(Fujii: Fig. 5, circuit board 14).**



**(Original 103(a) rejection)** Regarding **claim 20**, Fujii in combination with Lee teaches the method of claim 18 above wherein a background of said laminographic image are out of focus shadows of said circuit board and components on said circuit board **(Fujii: column 9, lines 39-43)**.

**Summary of applicant's remarks:** Regarding claims 18-20, Lee does not teach claim 1, from which claims 18-20 depend, and Fujii does not teach that which is missing from Lee.

**Examiner's response:** Lee does not teach claim 1. However, Fujii in combination with Lee teaches claim 1, as discussed in the new 103(a) rejection of claim 1 above.

The original 103(b) rejections are maintained.

8. **(New grounds) Claim 13** is rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii combined with Lee as applied to claim 1 above, and further in view of Cline (US 6058218).

**(New 103(a) rejection)** Fujii combined with Lee teaches the method of claim 1.

Fujii combined with Lee does not teach the method wherein said image is a negative and said morphological filter employs an erosion.

However Cline teaches the morphological operation of an erosion on a negative image **(column 2, lines 51-53 in view of column 4, lines 22-23, i.e. dilation on an image is equivalent to erosion on the negative (background))**.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Lee with Cline's operation. The motivation to combine being to enhance the desired structures **(Cline: column 2, lines 54-56)**.

**Summary of applicant's remarks:** claims 9-11 and 15-17 depend from claim 1, and Shih does not teach that which is missing from Lee.

**Examiner's Response:** Regarding claims 9-11 and 15-17, the lack of limitation in Lee is resolved in the combination of Fujii with Lee. That which is missing from the combined teaching of Fujii and Lee is taught by Shih.

The original 103(a) rejections are withdrawn and alternate 103(a) rejections are provided above.

9. **(New grounds) Claim 14** is rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii combined with Lee as applied to claim 1 above, and further in view of Loce.

**(New 103(a) rejection)** Fujii combined with Lee teaches the method of claim 1.

Fujii combined with Lee does not explicitly teach the method wherein said image is a negative and said morphological filter employs an opening.

However Lee teaches the method wherein said image is an original and said morphological filter employs a closing **(page 536, lines 3-8)** and Loce discloses that

an opening performed on a negative (**background**) is equivalent to a closing performed on the original (**column 6, lines 49-52**).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Lee with Loce's teaching. The motivation to combine being to improve processing efficiency.

**Summary of applicant's remarks:** Claim 14 depends from claim 1, and Loce does not teach that which is missing from Lee.

**Examiner's Response:** Regarding claim 14, the lack of limitation in Lee is resolved in the combination of Fujii with Lee. That which is missing from the combined teaching of Fujii and Lee is taught by Loce.

The original 103(a) rejection is withdrawn and an alternate 103(a) rejection is provided above.

10. **(New grounds)** Claims 22, 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii combined with Loce as applied to claim 21 above, and further in view of Cline.

**(New 103(a) rejection)** Regarding **claim 22**, Fujii combine with Loce teaches the method of claim 21. Fujii combines with Loce does not teach the method wherein the said morphological operation is a dilation.

However, Cline discloses the morphological operation of a dilation followed by a subtraction (**column 2, lines 51-53**).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Loce with Cline's operation. The motivation to combine being to enhance the desired structures **(Cline: column 2, lines 54-56)**.

**(New 103(a) rejection)** Regarding **claim 24**, Fujii combine with Loce teaches the method of claim 21. Fujii combines with Loce does not teach the method wherein the said image is a negative and said morphological operation is an erosion.

However, Cline teaches the morphological operation of an erosion on a negative image **(column 2, lines 51-53 in view of column 4, lines 22-23, i.e. dilation on an image is equivalent to erosion on the negative (background))**.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Loce with Cline's operation. The motivation to combine being to enhance the desired structures **(Cline: column 2, lines 54-56)**.

**Summary of applicant's remarks:** Claims 22 and 24 depend from claim 21, and Cline does not teach that which is missing from Loce.

**Examiner's Response:** Regarding claims 22 and 24, the lack of limitation in Loce is resolved in the combination of Fujii with Loce. That which is missing from the combined teaching of Fujii and Loce is taught by Cline.

The original 103(a) rejections are withdrawn and alternate 103(a) rejections are provided above.

11. **(New grounds)** Claims 26-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii combined with Loce as applied to claim 21 above, in view of Cline and further in view of Segall.

**(New 103(a) rejection)** Regarding **claim 26**, Fujii combined with Loce teaches the method of claim 21. Fujii combined with Loce does not teach the method wherein said performing a mathematical morphological operation comprises dilation of said image using power of two structuring element.

However, Cline discloses the morphological operation of a dilation **(column 2, lines 51-53)**.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Loce with Cline's operation. The motivation to combine being to enhance the desired structures **(Cline: column 2, lines 54-56)**.

Fujii combined with Loce combined with Cline do not disclose the morphological operation of dilation using of a power of two structuring element.

However, Segall discloses a method wherein dilation uses a power of two structuring element **(page 177, right column, lines 28-36, i.e. reducing image resolution by a factor of 2 increases the relative size of the structuring element by a factor of 2)**.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Loce

and Cline with Segall's method. The motivation to combine being to improve computational efficiency and system robustness (**Segall: page 182, right column, lines 3-4**).

**(New 103(a) rejection)** Regarding **claim 27**, Fujii combined with Loce teaches the method of claim 21.

Fujii combined with Loce does not teach the method wherein said performing a mathematical morphological operation comprises dilation of said image using a bi-directional power of two structuring element.

However, Cline discloses the morphological operation of a dilation (**column 2, lines 51-53**).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Loce with Cline's operation. The motivation to combine being to enhance the desired structures (**Cline: column 2, lines 54-56**).

Fujii combined with Loce combined with Cline do not disclose the morphological operation of dilation using of a bi-directional power of two structuring element.

However, Segall discloses a method wherein dilation uses a bi-directional (**i.e. rows and columns, page 177, right column, lines 34-36**) power of two structuring element (**page 177, right column, lines 28-36, i.e. reducing image resolution by a factor of 2 increases the relative size of the structuring element by a factor of 2**).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Loce and Cline with Segall's method. The motivation to combine being to improve computational efficiency and system robustness (**Segall: page 182, right column, lines 3-4**).

**Summary of applicant's remarks:** Claims 26 and 27 depend from claim 21, and Cline and Segall do not teach that which is missing from Loce.

**Examiner's Response:** Regarding claims 26 and 27, the lack of limitation in Loce is resolved in the combination of Fujii with Loce. That which is missing from the combined teaching of Fujii and Loce is taught by Cline and Segall.

The original 103(a) rejections are withdrawn and alternate 103(a) rejections are provided above.

12. **(New grounds)** Claims 28 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over of Fujii combined with Loce as applied to claim 21 above, and further in view of Segall.

**(New 103(a) rejection)** Regarding **claim 28**, Fujii combined with Loce teaches the method of claim 21.

Fujii combined with Loce does not teach the method wherein said performing a mathematical morphological operation comprises computing morphological operators such that the area of influence of the structuring element expands in a plurality of directions by up to a power of two during said operation.

However, Segall discloses a method wherein performing a mathematical morphological operation comprises computing morphological operators (**page 177, left column, equation 1, i.e. using structuring element K as in page 177, right column, lines 16-22**) such that the area of influence of the structuring element expands in a plurality of directions (**i.e. rows and columns, page 177, right column, lines 34-36**) by up to a power of two during said computation (**page 177, right column, lines 28-36, i.e. reducing image resolution by a factor of 2 increases the area of influence of the structuring element by a factor of 2**).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Loce with Segall's method. The motivation to combine being to improve computational efficiency and system robustness (**Segall: page 182, right column, lines 3-4**).

**(New 103(a) rejection)** Regarding **claim 35**, Fujii combined with Loce teaches the method of claim 21.

Fujii combined with Loce does not teach the method wherein said performing a mathematical morphological operation comprises computation of morphological operators such that the area of influence of the structuring element expands in each direction by up to a power of two during said computation.

However, Segall discloses a method wherein a morphological filter computes morphological operators (**page 177, left column, equation 1, i.e. using structuring element K as in page 177, right column, lines 16-22**) such that the



area of influence of the structuring element expands in each direction **(i.e. row and column, page 177, right column, lines 34-36)** by up to a power of two during said computation **(page 177, right column, lines 28-36, i.e. reducing image resolution by a factor of 2 increases the area of influence of the structuring element by a factor of 2).**

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified Loce's teaching with Segall's method. The motivation to combine being to improve computational efficiency and system robustness **(Segall: page 182, right column, lines 3-4).**

**Summary of applicant's remarks:** Claims 28 and 35 depend from claim 21, and Segall does not teach that which is missing from Loce.

**Examiner's Response:** Regarding claims 28 and 35, the lack of limitation in Loce is resolved in the combination of Fujii with Loce. That which is missing from the combined teaching of Fujii and Loce is taught by Segall.

The original 103(a) rejections are withdrawn and alternate 103(a) rejections are provided above.

13. **(New grounds)** Claims 29-31, 33 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii combined with Loce as applied to claim 21 above, in view of Cline, and further in view of Shih.

**(New 103(a) rejection)** Regarding **claim 29**, Fujii combined with Loce teaches the method of claim 21.

Fujii combined with Loce does not teach the method wherein performing a mathematical morphological operation comprises dilation of said image.

However, Cline discloses the morphological operation of a dilation (**column 2, lines 51-53**).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified Loce's method with Cline's operation. The motivation to combine being to enhance the desired structures (**Cline: column 2, lines 54-56**).

Fujii combined with Loce combined with Cline teach the method of claim 21 wherein performing a mathematical morphological operation comprises dilation of said image.

Fujii combined with Loce combined with Cline do not disclose the method of claim 21 wherein performing a mathematical morphological operation comprises dilation of said image using a terraced structuring element.

However, Shih discloses a mathematical morphological operation using a terraced structuring element (**page 363, Fig. 3, i.e. a convex element with  $s_1$  smaller than  $s_2$  smaller than  $s_3$** ).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Loce and Cline, with Shih's method. The motivation to combine being to improve performance.

**(New 103(a) rejection)** Regarding **claim 30**, Fujii combined with Loce teaches the method of claim 21.

Fujii combined with Loce does not teach the method wherein said performing a mathematical morphological operation comprises dilation by a sloped structuring element.

However, Cline discloses the morphological operation of a dilation **(column 2, lines 51-53)**.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Loce with Cline's operation. The motivation to combine being to enhance the desired structures **(Cline: column 2, lines 54-56)**.

Fujii combined with Loce combined with Cline teach the method of claim 21 wherein performing a mathematical morphological operation comprises dilation of said image.

Fujii combined with Loce combined with Cline do not disclose the method of claim 21 wherein said performing a mathematical morphological operation comprises dilation by a sloped structuring element.

However, Shih discloses a method of performing a mathematical morphological operation using a sloped structuring element **(page 362, Fig. 1)**.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Loce

and Cline with Shih's method. The motivation to combine being to improve performance.

**(New 103(a) rejection)** Regarding **claim 31**, Fujii combined with Loce, Cline and Shih teach the method of claim 29 above wherein said structuring element is smoothly sloped **(Shih: page 362, Fig. 1)**.

**(New 103(a) rejection)** Regarding **claim 33**, Fujii combined with Loce, Cline and Shih teach the method of claim 31 wherein said performing a mathematical morphological operation comprises at least one piecewise linear dilation by a structuring element of limited support **(Shih: page 356, equation 1, with structuring element k as in page 363, Fig. 3)**.

**(New 103(a) rejection)** Regarding **claim 34**, Fujii combined with Loce, Cline and Shih teach the method of claim 31 wherein said performing a mathematical morphological operation comprises at least one piecewise linear dilation by a structuring element of limited support **(Shih: page 356, equation 2, with structuring element k as in page 363, Fig. 3)**.

**Summary of applicant's remarks:** Claims 29-31, 33 and 34 depend from claim 21, and Cline and Shih do not teach that which is missing from Loce.

**Examiner's Response:** Regarding claims 29-31, 33 and 34, the lack of limitation in Loce is resolved in the combination of Fujii with Loce. That which is missing from the combined teaching of Fujii and Loce is taught by Cline and Shih.

The original 103(a) rejections are withdrawn and alternate 103(a) rejections are provided above.

14. **(New grounds) Claim 32** is rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii combined with Loce as applied to claim 21 above, and further in view of Shih.

Fujii combined with Loce teaches the method of claim 21.

Fujii combined with Loce does not teach the method wherein said performing a mathematical morphological operation comprises decomposing a structuring element.

However, Shih discloses a method of decomposing a structuring element (**page 356, right column, lines 42-45**).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Loce with Shih's method. The motivation to combine being to reduce calculations (**Shih: page 356, right column, lines 23-24**).

**Summary of applicant's remarks:** Claim 32 depends from claim 21, and Shih does not teach that which is missing from Loce.

**Examiner's Response:** Regarding claim 32, the lack of limitation in Loce is resolved in the combination of Fujii with Loce. That which is missing from the combined teaching of Fujii and Loce is taught by Shih.

The original 103(a) rejection is withdrawn and an alternate 103(a) rejection is provided above.

15. **(New grounds)** Claims 36 and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii combined with Loce as applied to claim 21 above, and further in view of Lee.

**(New 103(a) rejection)** Regarding **claim 36**, Fujii combined with Loce teaches the method of claim 21.

Fujii combined with Loce does not teach the method further comprising thresholding an image resulting from said differentiating to provide a binary image of said objects.

However Lee teaches a mathematical morphological method further comprising thresholding an image resulting from said differentiating to provide a binary image of said objects **(page 536, lines 17-21)**.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified Loce's teaching with Lee's method. The motivation to combine being to enhance automatic segmentation of specific features **(Lee: page 534, lines 2-3)**.

**(New 103(a) rejection)** Regarding **claim 37**, Fujii combined with Loce combined with Lee teaches the method of claim 36 further comprising extracting said image resulting from said thresholding to disclose pixels representing said objects **(Lee: page 536, lines 10-12, i.e. hair mask)**.

**Summary of applicant's remarks:** Claims 36 and 37 depend from claim 21, and Lee does not teach that which is missing from Loce.

**Examiner's Response:** Regarding claims 36 and 37, the lack of limitation in Loce is resolved in the combination of Fujii with Loce. That which is missing from the combined teaching of Fujii and Loce is taught by Lee.

The original 103(a) rejections are withdrawn and alternate 103(a) rejections are provided above.

16. **(Original grounds)** Claims 38-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii combined with Loce as applied to claim 21 above.

**(Original 103(a) rejection)** Regarding **claim 38**, Fujii combined with Loce teaches the method of claim 21 wherein the examination elements are solder joints **(Fujii: Fig. 5, solder joints 25)**.

**(Original 103(a) rejection)** Regarding **claim 39**, Fujii combined with Loce teaches the method of claim 38 above wherein said solder joints are on a circuit board **(Fujii: Fig. 5, circuit board 14)**.

**(Original 103(a) rejection)** Regarding **claim 40**, Fujii combined with Loce teaches the method of claim 39 above wherein said background comprises out of focus shadows of said circuit board and components on said circuit board **(column 9, lines 39-43)**.

**Summary of applicant's remarks:** Claims 38-40 depend from claim 21, and Fujii does not teach that which is missing from Loce.

**Examiner's Response:** Regarding claims 38-40, the lack of limitation in Loce is resolved in the combination of Fujii with Loce as discussed in the new 103(a) rejection of claim 1 above.

The original 103(a) rejections are maintained.

17. **(New grounds) Claim 44** is rejected under 35 U.S.C. 103(a) as being unpatentable over Fujii combined with Shih as applied to claim 41 above, and further in view of Loce.

Fujii combined with Shih teaches the method of claim 43.

Fujii combined with Shih does not teach that the image is a negative.

However Loce discloses a morphological operation on a negative image (**column 8, lines 14-16**).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have modified the teaching of Fujii combined with Shih with Loce's disclosure. The motivation to combine being to identify and process particular structures of interest (**Loce: column 8, lines 23-28**).

**Summary of applicant's remarks:** Claim 44 depends from claim 41, and Loce does not teach that which is missing from Shih.

**Examiner's Response:** Regarding claim 44, the lack of limitation in Shih is resolved in the combination of Fujii with Shih. That which is missing from the combined teaching of Fujii and Shih is taught by Loce.



The original 103(a) rejection is withdrawn and an alternate 103(a) rejection is provided above.

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Clifton G. Daley whose telephone number is 571-270-3144. The examiner can normally be reached on Monday - Friday 7:30am - 4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Samir Ahmed can be reached on 571-272-7413. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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